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REPORT

OF

THE COMMISSIONERS FOR THE ERECTION OF THE PUBLIC BUILDINGS

TO

HON. WILLIAM B. SMITH,

MAYOR OF PHILADELPHIA,

OF

THEIR OPERATIONS DURING THE YEAR 1885.

WITH AN

APPENDIX,

CONTAINING REPORT OF PROF. GEORGE F. BARKER UPON
PROTECTION OF THE BUILDINGS FROM LIGHTNING;
EXTRACT FROM ANNUAL REPORT OF CHIEF OF
THE ELECTRICAL DEPARTMENT;

AND

COPY OF THE ACT OF ASSEMBLY, APPROVED AUGUST 5, 1870,
CONSTITUTING THE COMMISSION.

PHILADELPHIA:
PRINTED FOR THE COMMISSIONERS.
1886.

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THE COMMISSIONERS FOR THE ERECTION OF THE PUBLIC BUILDINGS

TO

HON. WILLIAM B. SMITH,

Mayor of Philadelphia,

OF

THEIR OPERATIONS DURING THE YEAR 1885.

OFFICE OF THE

Commissioners for the Erection of the Public Buildings.

PHILADELPHIA, *April* 2, 1886.

HON. WILLIAM B. SMITH,
Mayor of Philadelphia.

DEAR SIR:—In reply to your request for a statement of the operations of the Commissioners for the year ending December 31, 1885, it is with pleasure they send the following:

The balance to the credit of the Commissioners on the 31st of December, 1884, was	$26,589 13
There was appropriated for the year 1885, by the City Councils, for the general purposes of the Commissioners, .	750,000 00
And in addition a special amount towards the paving of the roadways surrounding the buildings, of . . .	50,000 00
Making a total, applicable to the purposes of the Commissioners during the year 1885, of	$826,589 13
Of this there had been expended, up to December 31, 1885, ...	812,850 17
Leaving an unexpended balance carried to their credit for the present year (1886) of	$13.738 96

There were, however, outstanding claims and demands against the Commissioners, amounting to about $150,000, including the sum of $40,805 69 due to Messrs. Struthers & Sons, on special warrants, besides interest, all of which had to be immediately paid out of the appropriation of $500,000, made for the general purposes of the Commissioners during the year 1886, by ordinance approved December 28, 1885, so soon as the same was available.

During the past year (1885) the whole of the slating and asphalt covering of the roofs have been completed; the polished granite, sandstone and bronze work of the public stairways in the southeast and southwest corner pavilions have been finished; seventy (70) feet of marble and brick masonry have been added to the clock tower, making the entire height at this date 266 feet 4½ inches above the pavement level; the battery room, and rooms for general business of the Police and Fire Alarm Department, have been fitted up, and are now ready for the reception of the electric instruments. There has also been constructed for use of this department a sub-way for wires, extending from the northeast corner of the building to Juniper and Filbert Streets. This sub-way has also been used for the introduction into the building, for temporary and auxiliary use, of a twelve-inch water main, connected with the new main of the city water works on Juniper Street. An extract from the Annual Report for 1885 of the Chief of the Electrical Department, which will be found in the Appendix, gives a fuller detail of the arrangements for the Police and Fire Alarm Telegraph.

The entire roadways surrounding the site have been regraded and covered with asphalt upon an eight-inch bed of cement concrete. The principal items other than those mentioned are carpenters' work, copper work, painting, labor, brick and cement work.

During the present year (1886) it is proposed to continue the marble work on the clock tower seventy-one feet, which will complete the masonry of that structure to the base of the metal work of the clock story and cupola, a height of three hundred and thirty-seven feet four and a half inches. An hydraulic elevator is now being erected in the tower to deliver materials and passengers upon the upper floors, and to be extended as the work of construction progresses.

It is also proposed to fit the boiler-house intended for the electric light and hydraulic elevator systems of the eastern half of the building, in the northeast portion of the court-yard, with engines, boilers and other appliances necessary for their permanent operation. The heating and ventilating apparatus for the western half of the building, postponed last year owing to want of sufficient appropriation, has been commenced and will be advanced as far as the allotment for that branch of the work will permit.

The arrangements for the proper distribution of the permanent water supply, after it shall have been introduced to the various parts of the building, and which will involve considerable outlay, will be commenced, and, it is expected, completed.

The balance of the appropriation will be expended in preparing for plastering that portion of the building allotted for the courts and their appurtenances.

In reference to the water supply for the buildings the questions to be met relate to the quantity required, the source from which it shall be obtained, and the method and means for its distribution after it is introduced. The Commissioners, at their meeting February 3, 1885, upon the recommendations of the Committee on Water Supply, based on the report of Howard Murphy, C.E., to which reference was made in the Commissioners' Report for the year 1884, and which has been printed and copies furnished to Councils and the City Departments, adopted the following resolutions, subject to the approval of the Chief Engineer of the Water Department:

1. *Resolved,* That a gravity supply from Belmont Reservoir, with the necessary connection with the Fairmount main and pumping capacity sufficient for use in emergency, be adopted for the supply of the City Hall.

2. *Resolved,* That the gravity supply from Belmont Reservoir be by a special 12-inch main, to be laid for the exclusive use of the City Hall, from the Belmont Reservoir by Belmont, Elm and Girard Avenues, to a point east of the Philadelphia and Reading Railroad, thence through the Park back of the Zoological Gardens, and along Thirtieth Street to Market, and thence due east along Market Street to the City Hall.

3. *Resolved,* That the route indicated be surveyed, and the specifications and plans for the construction thereof be prepared during the present year.

4. *Resolved,* That for the present year the necessary connections shall be made with the Fairmount main, through the attachment already made, access to which has been provided for from the northeast corner of the buildings; and that the necessary tankage be provided, with the pipes leading thereto, and the pumping engine for the supply of the same, together with all necessary

connections and appliances for the attachment of the 12-inch main from Belmont Reservoir, when it shall have been completed, being introduced into the buildings without disturbing the new roadway now being laid down.

5. *Resolved,* That the construction of the special 12-inch main from the Belmont Reservoir be deferred until next year.

Col. William Ludlow, the then Chief Engineer of the Water Department, signified his approval, under date of February 9, as follows: "I beg to say that the securing of either temporary or permanent supply by the means specifically indicated in the resolutions meets with my approval."

The following extracts from the Report of Mr. Murphy serve to show the magnitude and importance of the questions involved:

> "While the City Hall cannot be classed as an establishment requiring water for prospective use in the arts, the only purposes for which it should be available are not included in drinking, sanitary, steam and fire. Electricity, as applied to the purposes of ordinary business, is yet in its infancy, and its laboratory must have a water supply. The familiar 'blue process,' for the reproduction of drawings, etc., has lately grown into almost universal use in engineering and other offices. It requires, when properly done, a very considerable quantity of water. In short, the whole tendency of the age indicates an increasing application of the resources of nature to every-day life, and the day when one 'public pump' was sufficient for a whole block of houses is past.
>
> "Liberality in provision is also demanded by the fact that it is desirable to manipulate water at low velocities. The full and free use of the system should not necessitate a high velocity in any part thereof, as the shock incident to a sudden check in the rapid flow of water may be attended by a more or less serious and extended rupture of the appliances and consequent injury to the building and its contents.
>
> "And last, but not least, is the fact that, when the total consumption during a given period has been determined, it by no means follows that appliances capable of delivering this quantity, at a safe and uniform rate, during that period, are adequate; for

the consumption is not at a uniform rate, and the full use of any portion should not cut off, or inconveniently reduce the discharge of, any other portion of the system. Every one has appreciated this when, under old-fashioned plumbing, the turning on of the water in the kitchen would stop its flow on the second floor.

"In this building, as elsewhere, the maximum will be more than double the average rate of consumption.

"It may here be stated that the quantity which the following pages show to be possible should not, for these reasons, be handled in a main less than twelve inches in diameter.

"The importance of the most thorough flushing of sanitary appliances is too well recognized by you to need any comment; although it is also to be assumed that where good business management generally prevails, water, which has a positive value per unit, is not intentionally wasted for this purpose."

As to the sources of supply the engineer states the question thus:

"Whence may this supply be obtained? The means at your disposal are—by the collection and storage of the rainfall upon your roof; by driven wells; by artesian wells; and, from the city works, by pumping from the mains now at hand, or laying a special main to a point at which a gravity supply can be tapped."

After discussing at length the other means of supply mentioned, and showing their inadequacy as to quantity and quality, the report concludes with the consideration and recommendation of a gravity supply from Belmont Reservoir, as follows:

"Belmont Reservoir is next to be considered. It is, in fact, the only resource for a gravity supply, as the elevation of none of the other basins is sufficient to afford it. It has also one feature of especial desirability. Its surface is coincident with the available water surface in your middle pavilions, thus rendering the full head of its distribution always available, and the overflow of the pipe impossible. The City Hall pavement being 40 feet above City Datum, the surface of this reservoir has a super-elevation of 172 feet, and its bottom of 147 feet above your curb. Supposing at least the average super-elevation of 159½ feet to be maintained, a 12-inch pipe would deliver at the elevation of your highest fixture at the rate of 33,000 gallons per hour, at a velocity of about 1$\frac{6}{10}$ feet per second.

"Tanks in the building, to a point therein 12½ feet above this high fixture, would fill, at that point, at the same rate, when Belmont Reservoir was full.

"With but 1 foot of water maintained in Belmont Reservoir, tanks with bottoms at the level of this high fixture would receive about 400,000 gallons of water in 24 hours.

"This supposes the extreme of unfavorable conditions; Belmont Reservoir within one foot of being empty, and all the water for the City Hall drawn after being delivered 15 feet above the highest required fixture; whereas the reservoir may be expected to be generally nearly full, and but a comparatively trifling quantity of water will be required at that great elevation in the building. A maximum possible discharge in the sub-basement of from 83,000 to 89,000 gallons per hour might be expected. This maximum discharge is noted simply to show the capacity of a 12-inch main under the existing conditions, for that delivery might never be required, and would necessitate a higher velocity in the structure than is desirable.

* * * * * * *

"The selection of a line for the main involves various considerations. If connection is made with the outskirts of the West Philadelphia distribution, there is little choice of lines; but if you should decide to extend to the reservoir itself, a location avoiding the important thoroughfares, as far as possible, is recommended. It is desirable not to disturb travel on such streets; the space therein will be needed for other conduits, the laying of which may disturb your main; and last, but not least, the danger of accidental or intentional connections therewith depends upon its accessibility. In any case, your main should be distinguishable from others by lettering cast upon it.

* * * * * * *

"In the case of a special main through West Philadelphia to the reservoir, the route via Market Street, Lancaster Avenue and Belmont Avenue, which would appear at first glance to be the most natural, is open perhaps more than any other to the objections noted, as it would occupy the most important highways in the district.

"Any route via West Philadelphia would be along Market Street from Broad Street to beyond the Schuylkill, on account of its directness and because the proposed new bridge will afford the only convenient facilities for crossing the river.

"The writer, however, would recommend leaving Market Street at Thirtieth and proceeding along that street to the Fairmount bridge. Thirtieth Street is permanently enclosed by railroad property, may never be largely occupied by conduits, and is not much travelled at present. From Thirtieth and Spring Garden Streets the line could follow the drive through the Park and back of the Zoological Garden to Girard Avenue.

"From this point the writer considered several lines through the Park, but concluded that the interference with the grading of new walks and drives and the foundations of future buildings, the probable rock and roots, the disturbance of the lawns, the greater difficulty in tracing location of pipe in case of accident, and the summits and depressions occurring in the line, would more than balance the advantages of shorter distance, no repaving, isolation of pipe, etc.

"A line along the tow-path to the 30-inch main near the Belmont engine-house might be very expensive, on account of rock excavation and flooding of the trench.

"It would, therefore, seem better to proceed along Girard and Elm Avenues, under the sidewalk adjoining the Park, to the Belmont Avenue Park entrance, the balance of this line depending upon the future arrangements of the Water Department. A 20-inch main now extends intact to within about 100 feet of Elm Avenue, but its entire service, at a dangerous velocity, is at present demanded by the West Philadelphia distribution, and will be until the proposed new West Philadelphia mains are built; so the line would *now* have to proceed along Belmont Avenue to the 30-inch main now crossing it.

"The following lengths were obtained, as closely as the present stage of the subject demands, and are sufficiently accurate for comparative purposes:

	On much travelled streets.	On little travelled streets.	Total streets.	Park.	Total length.	Estimated cost.
Tow-path, ...	5,600	3,300	8,900	11,400	20,300	$40,600
Park, ...	5,600	3,300	8,900	13,100	22,000	44,000
Lancaster Avenue, .	19,000	. . .	19,000	3,600	22,600	45,200
Elm Avenue, . . .	5,600	8,300	13,900	9,400	23,300	46,600

"The two latter lines would each be shortened about 3500 feet if connection could be made with the 20-inch main near Belmont entrance to the Park.

WEST PHILADELPHIA ATTACHMENT.

"The remaining means of tapping Belmont is by attaching to its distribution at the west end of Market Street bridge, or points beyond hereafter indicated, whence a full supply may be obtained if the West Philadelphia distribution is reinforced as now proposed, and under the latter condition it is certainly a reliable and economical method. It would avoid the possible failure of the submerged main on the first route discussed and the additional expense of an entire line to the basin.

"The compounding of your 12-inch main with the 20-inch main now laid would give a much larger discharge than a simple 12-inch main over the same route, neglecting the effect of the lateral draughts thereupon. The exact behavior of your supply under these draughts cannot be determined beforehand; but if the general West Philadelphia distribution is augmented, as proposed, by a 30 or 36-inch main on Fifty-second Street, and if, as is expected, manufacturing establishments and other large consumers will not multiply west of the river to a great extent, a very satisfactory delivery may be expected.

"A full discharge at night would be certain, and, if this scheme is adopted, a limited tank-storage capacity only need be provided at first, subject to additions regulated by increase of consumption in the building and reduced pressure during the day from lateral draughts on the main.

"There is ample tank space in the building, and additions to the tank capacity need involve no waste as to the structures already in place. In other words, if ten or twenty tanks will be ultimately required, they can be built about as economically one at a time. Reserve storage capacity will be required under any conditions and any means of supply.

"It is about 5000 feet to the west end of Market Street bridge. About 1600 feet of 12-inch main are now laid beyond that point. If this is used as a portion of your main to Thirty-eighth and Market Streets, a total of about 8200 feet will have to be built. A better plan would be to proceed up Lancaster Avenue to meet the 20-inch main at Fortieth Street. Using the 12-inch main on Market Street, as before, this would require about 10,300 feet of pipe. The latter route, omitting the use of the present 12-inch pipe on Market Street, would be better still, requiring a total of about 11,900 feet of pipe. The approximate costs would be respectively $16,400, $20,600 and $23,800, as compared with a minimum of $28,000 by any other route.

"The objection to the above is that greater variableness of pressure may be expected than by most of the other routes investigated; but this would not seem to be a material objection, as it is not to be supposed that the city will ever allow its own buildings to be deprived of their supply.

"Attachment to this system is just now impossible, as it cannot meet its present requirements; but the probabilities are that the proposed West Philadelphia mains on Fifty-second Street and Lancaster Avenue will be built within one or two years.

"In connection with any gravity system limited pumping capacity should be provided as a reserve in view of possible accident.

"Attachment to the adjacent Fairmount 20-inch main, and the introduction of a Compound Worthington pump at a cost of $2500, will cover this ground.

TANKS.

"As to tanks for storage, each should be as large as circumstances will admit, as the cost per unit of capacity diminishes as the size increases. As the weight, however, upon the supports of a tank is equal to over 62½ pounds per square foot of bottom, per foot of depth, very deep tanks would be inconvenient to support in your building. Separation of the tanks is also essential for purposes of cleaning and repairs and in case of accident. Tanks of about 40,000 gallons capacity would, perhaps, be a convenient and economical size, adapted in shape to their proposed locations. They would probably cost about $1200 each.

"It is respectfully recommended that a gravity supply from Belmont Reservoir, with reserve connection with the Fairmount main and pumping capacity sufficient for use in emergency, be adopted for the supply of the City Hall. The latter will serve your more immediate requirements, and it can be introduced as soon as funds are available for that purpose."

The details for distribution of the water, after the supply had been secured and introduced into the buildings, were left for further consideration, after definite action should have been taken in regard to the source from which the supply should be derived.

The advancing height of the tower led the Commissioners, in the early part of July, to take into serious consideration the protection of the buildings against lightning; and the matter having been referred to a special committee, consisting of the President, Architect and Superintendent, with power to employ an electrical expert to make a thorough preliminary examination, the services of Prof. George F. Barker of the University of Pennsylvania were obtained, and the result of his labors is set forth in his Report, under date of November 16, 1885, and which is printed in the Appendix.

Briefly the plan recommends, (1) The protection of the tower during its erection by providing a complete and continuous metallic conductor, properly terminated at the ends, extending from the base of the tower to its summit; two conductors at least to be employed of copper-wire rope, not less than an inch in diameter, made of rather large size wire, to be connected metallically at frequent intervals with the iron framework of the main building; the ground connection to be secured by terminating the conductors in the deep well already in existence in the centre of the tower foundations; the upper terminals of the conductors to be firmly connected with the circular iron track on which the steam derrick revolves, and from which suitable lengths of same copper-wire rope should be carried to the most prominent parts of the derrick, and each of these lengths to terminate two feet or more above the highest point of attachment, the end of the rope to be untwisted so as to present a brush of separate metallic wires.

(2) The protection of the buildings themselves; by making the flagstaffs of the four centre pavilions terminate in a number of sharp points of malleable nickel.

The Report was accepted and approved at the stated meeting, December 1, 1885, and referred to the same committee, to carry out in detail the suggestions contained therein. It is hoped the necessary arrangements will be completed during the coming season, so that the building, as it progresses, will be fully protected against damage from lightning.

The following materials have been received at the building and used during the year ending December 31, 1885:

2,340	cubic feet of dressed granite (Mass.).
74	tons 1829 lbs. cast-iron door trimmings, cornices, ceilings, etc.
30	tons 1869 lbs. rolled-iron beams and girders for floors and roofs.
34	tons 1682 lbs. wrought-iron clamps, tie rods, bolts, braces and railings.
3	tons 266 lbs. copper.
2,178,800	hard bricks.
9,350	enamelled bricks.

There have been used in the construction, from the commencement of the work to the 31st of December, 1885, the following materials:

80,325	cubic feet of concrete foundations.
839,532¼	cubic feet of foundation stone from Conshohocken, Pa.
225,581	cubic feet of dressed granite from Concord, N. H., Blue Hill, Me., and Cape Ann, Mass.
700,779.4″	cubic feet of marble from Lee, Mass.
116,231.8″	cubic feet of buff and blue sandstone from Ohio.
3,192	cubic feet of sandstone from Hummelstown, Pa.
41,536	cubic feet of polished granite from the quarries on the Magaguadavic River, near St. George, N. B., and from Quincy and Cape Ann, Mass.
12,500	cubic feet of polished marble from Rutland, Vt., and Montgomery county, Pa.
67,995,500	hard bricks from Philadelphia.
236,020	pressed bricks from Philadelphia.
161,750	white bricks from Philadelphia.
176,288	enamelled bricks from Philadelphia.
3,754	tons 1565 lbs. of rolled iron for floors and roofs.
139	tons 1806 lbs. of wrought-iron clamps, ties, bolts and railings.
2,339	tons 1603 lbs. of cast-iron door and window dressings, askewbacks, bricks, ceilings, cornices, plates and lintels, etc.
22	tons 107 lbs. copper.

26,298	square feet of bond slate.
96,700	square feet of roofing slate, sawed and planed, and weighing 794 tons.

Whole number of bricks of all kinds, 68,569,558.

The excavations for the cellars and the foundations required the removal of 145,879 cubic yards of earth.

The entire amount appropriated by Councils to the Commissioners since 1872, when the first appropriation was made, to 1885, both years inclusive, is	$9,866,609 88
No appropriation whatever was made for the year 1877; and no special tax has been levied since 1876 for the Public Buildings,—the appropriations for 1878 and the subsequent years having been made out of the general annual tax.	
To the appropriations thus made there should be added the amounts of special warrants issued by the Commissioners to William Struthers & Sons for bills under their contract for the marble and marble work of the exterior, in addition to bills under their contract which were paid out of the appropriations, ...	1,194,330 19
Making a total of	$11,060,940 07
Deducting from this the total amount of expenditures by the Commissioners up to the close of the year 1885, .	11,047,201 11
Leaves the balance, as above stated, of	$13,738 96

The reduction in the amount of special warrants stated as issued to William Struthers & Sons, in the report of the Commissioners for 1884, has been accomplished in the following manner:

Amount stated as outstanding December 31, 1884, ...	$1,519,515 24
Amount since issued, . . .	277,190 54
Total, ...	1,796,705 78
Amount redeemed during 1884 and 1885, and paid by the Commissioners out of the regular appropriation, .	602,375 59
Amount outstanding or collected by mandamus to December 31, 1885, as above stated, ...	$1,194,330 19

The contract of Messrs. William Struthers & Sons for the marble and marble work of the exterior was for .		$5,300,000 00
Total amount of bills rendered under contract to December 31, 1885, . . .	$5,235,736 81	
Less per centage retained, . . .	33,007 66	
		$5,202,729 15
Total amount required to complete contract, ...		$97,270 85

Of the above stated amount of bills rendered, viz.,

$5,202,729.15, there remained outstanding at the close of the year the special warrants issued during 1885, amounting to $40,805.69.

The Commissioners would respectfully call attention to the very great reductions which have been made by Councils from the amounts required to be appropriated from year to year "for the purposes of the Commission;" and which reductions have largely increased the cost of the buildings, by the injury caused to the construction from lack of funds for its proper protection, and by the delay in making contracts for large and important items in the construction, whose completion was essential to the rapid and economical progress of other branches of the work.

Reference is renewed to the provisions of the Act of Assembly, approved August 5, 1870, and a copy of which will be found in the Appendix to this Report, for the powers, rights and duties of the Commissioners, as well as for the course of procedure by Councils touching the subject-matter of the enactment, enjoined by the Legislature of the State, which is the creative source of both Councils and Commissioners.

Respectfully submitted,

On behalf of the Commissioners.

SAMUEL C. PERKINS,
President.

APPENDIX.

COMMISSIONERS

FOR THE ERECTION OF THE PUBLIC BUILDINGS.

DECEMBER 31, 1885.

WILLIAM BRICE,
ISAAC S. CASSIN,
MAHLON H. DICKINSON,
THOMAS E. GASKILL,
JAMES R. GATES,
JOHN L. HILL,
CHARLES LAWRENCE,
HIRAM MILLER,
RICHARD PELTZ,
SAMUEL C. PERKINS,
WILLIAM B. SMITH,
WILLIAM S. STOKLEY,
WILLIAM H. WRIGHT.

OFFICERS.

PRESIDENT—SAMUEL C. PERKINS.
SECRETARY—WILLIAM B. LAND.
TREASURER—WILLIAM B. IRVINE.
SOLICITOR—SAMUEL PELTZ.

◆

ARCHITECT—JOHN McARTHUR, JR.

ASSISTANTS—JOHN ORD,
THOMAS U. WALTER.

SUPERINTENDENT—WILLIAM C. McPHERSON.

NEW CITY HALL, PHILADELPHIA.

DIMENSIONS OF BUILDING.

From North to South,	486 feet 6 inches.
From East to West,	470 feet.
Area,	4½ acres.
Height of Main Tower,	537 ft. 4½ in. above pavement.
Width at Base,	90 feet.
Centre of Clock Face,	361 feet above pavement.
Diameter of Clock Face,	20 feet.
Height of Upper Balcony,	296 feet above pavement.
Total Number of Rooms in Building,	520.
Total Amount of Floor-room is	14½ acres.
Height of each Centre Pavilion,	202 feet 10½ inches.
“ each Corner Tower,	161 feet.
“ Basement Story,	18 feet 3½ inches.
“ Principal Story,	33 feet 6 inches.
“ Second Story,	35 feet 7 inches.
“ Third Story, Centre Pavilion,	26 feet 6 inches.
“ “ “ Wings,	24 feet 3 inches.
“ “ “ Curtains,	20 feet 5 inches.
“ Attic of Centre Pavilions,	15 feet.
“ “ Corner Towers,	13 feet 6 inches.
“ Crowning Statue,	36 feet.
“ Figures on Centre Dormers,	17 feet 6 inches.
“ “ Corner Dormers,	12 feet 10 inches.

COMPARATIVE HEIGHTS

OF THE

PRINCIPAL BUILDINGS OF THE WORLD.

Washington Monument,	550 feet.
City Hall, Philadelphia,	537 “ 4½ inches.
Cologne Cathedral,	510 “
Great Pyramid,	480 “
Strasburg Cathedral,	468 “
St. Peter's, Rome,	448 “
St. Stephen's Cathedral, Vienna,	441 “
Salisbury Cathedral,	404 “
Toraccio of Cremona,	396 “
Freiburg Cathedral,	385 “
Amiens Cathedral,	383 “
Church of St. Peter, Hamburg,	380 “
The Cathedral, Florence,	376 “
Hotel de Ville, Brussels,	374 “
Torre Asinelli, Bologna,	370 “
St. Paul's, London,	360 “
Church of St. Isaac, St. Petersburg,	336 “
Cathedral, Frankfort-on-the-Main,	326 “
Bell Tower, St. Mark's, Venice,	323 “
Hotel des Invalides, Paris,	310 “
United States Capitol, Washington,	287 “
Masonic Temple, Philadelphia,	230 “

REPORT OF PROFESSOR GEORGE F. BARKER

ON THE

PROTECTION OF THE BUILDINGS FROM LIGHTNING.

Hon. Samuel C. Perkins,
President Public Buildings Commission.

Dear Sir:—Acting under the authority of the communication addressed to me by yourself, on the 16th of October, I have the honor to submit to you the following preliminary report upon the best method of protecting the tower of the New City Hall from damage by electricity during its progress.

The resolution of the Commission, providing for this report, is given in the communication above mentioned, and is as follows:

"*Resolved*, That in view of the height already attained in the progress of construction upon the tower, carrying it to a point beyond the protection against lightning afforded by the flag-staffs of the centre pavilions, the Executive Committee recommend to the Commissioners that a Committee consisting of the President, Architect and Superintendent be authorized to employ an electrical expert, at a cost not to exceed two hundred and fifty dollars, to make a thorough preliminary examination, with the view of arranging to properly protect the building against damage by lightning."

In accordance with this resolution I made such a preliminary examination of the building upon the 24th of October, being accompanied on the tour of inspection by yourself as the President of the Commission, and by Mr. McArthur as the Architect. In this examination particular attention was paid to the tower, as being the portion of the building to be more immediately provided for. In addition to this, I have carefully examined, in the office of the Architect, the plans and drawings of those parts of the building and the tower which are involved in the question under discussion, with a view to determine the means to be used in order to ensure the most perfect temporary protection.

As the result of these inspections and examinations I have to recommend the adoption of the following plans; the first having reference to the tower, the second to the remainder of the building:

A. PLAN FOR PROTECTING THE TOWER FROM DAMAGE BY LIGHTNING DURING ITS ERECTION.—This plan consists in providing a complete and continuous metallic conductor, properly terminated at the ends, extending from the base of the tower to its summit. The subject may be considered in three sections: first, the conductor itself; second, its lower terminal; and third, its upper terminal.

I. *The Conductor.*—In order to furnish a path for the electric discharge which shall be sufficient and satisfactory at all times and under all circumstances, two conductors at least should be employed. These, by preference, should be made of copper-wire rope, the wire to be of rather large size, certainly not smaller than No. 7 or 8 Brown & Sharp gauge, and the rope itself to be not less than one inch in diameter. These two conductors should pass through the two small shafts existing in the southeast and the southwest corners of the tower, and should there be so secured as to permit of easy adjustment with the increasing height of the tower. At as frequent intervals within these shafts as practicable these conductors should be metallically connected with the iron framework of the main building.

II. *The Lower Terminal.*—The copper-wire ropes used as conductors should terminate below with as perfect a ground-connection as it is possible to obtain. The best connection of this sort available is furnished undoubtedly by a well already excavated within the walls of the tower at its base, the bottom of which is considerably below the permanent water-level of the city of Philadelphia. Hence there is, at all times, several feet of water in this well. Beneath the water in this well both the conductors above mentioned should terminate, the excess of the wire rope being coiled up within the well. The length of the conductors should be so proportioned that when the marble work of the tower has reached its height, not less than thirty feet of each cable shall remain coiled at the bottom of the well. It would seem that abundant ground-connection ought to be secured in this way; quite sufficient certainly to dissipate readily and completely any probable charge of atmospheric electricity.

III. *The Upper Terminal.*—At their upper ends, the copper-wire conductors should be firmly connected with the circular iron track on which the steam derrick revolves, thus securing at all times the best metallic contact with the trucks on which this derrick rests. From the iron framework of these trucks suitable lengths of the same copper-wire rope should be carried to the most prominent points of the derrick, particularly to the corners of the upright central brace, to the stack of the boiler, the roof of the engine-house and the overhanging end of the derrick. Each of these lengths should terminate two feet or more beyond the point it is designed to protect, and the rope should be untwisted at its extremity, so as to present a brush of separate metallic wires.

From a careful and extended consideration of the conditions which are necessary in order to protect from lightning a structure of the character and the height of this tower, I am of the opinion that the conductors and terminals which have now been described are suitable and sufficient for the purpose, and that if properly erected and maintained they will effectually prevent any damage to this tower by lightning during the progress of erection.

B. Plan for Protecting the Building itself.—While it is quite true that "the height already attained in the progress of construction upon the tower carries it to a point beyond the protection against lightning afforded by the flag-staffs of the centre pavilions," to use the words of the resolution adopted by the Commission, it is also true that the influence of the tower, even if perfectly protected itself, cannot be relied upon for the protection of the pavilions. It is altogether undesirable, in my judgment, to have a lightning discharge fall upon any of these flag-staffs, if it can be avoided. To prevent this result therefore, so far as is possible, I would recommend that these flag-staffs be made to terminate in a number of sharp points, sufficient to protect them from such an explosive discharge. The metal of which these points are made should have a high conducting power and a high point of fusion, should not be acted on too readily by atmospheric influences, and should not be very expensive. Of all the metals available for the purpose malleable nickel seems to me to fulfill the conditions better than any other. I therefore recommend that the points to be used upon the flag-staffs be made of this metal.

The best information at present attainable upon this subject teaches us that a good lightning rod protects a circular area whose radius is the height of the rod. By drawing circles at the bases of the pavilions, with the distances to the tops of the flag-staffs as radii, it will be found that, according to this rule, these flag-staffs, thus pointed, will protect the entire roof of the building, since the circles thus drawn not only cover the roof but considerably overlap.

If the recommendations which have been set forth in this report shall be carried into effect, I am clearly of the opinion that the entire City Hall will be sufficiently protected from damage by lightning, until such time as it shall be completed. The installation of a permanent system of lightning protection for this building should rest on the basis of a thorough experimental investigation of its electrical condition. Such an investigation must therefore be made before any final system of protection can be recommended.

All of which is respectfully submitted.

GEORGE F. BARKER.

PHILADELPHIA, *November* 16, 1885.

EXTRACT FROM ANNUAL REPORT FOR 1885 OF CHIEF OF ELECTRICAL DEPARTMENT.

Quarters in New City Hall.

In the appropriation made in 1881 to this Department for the improvement and extension of the Police and Fire telegraphs, there was an item for the fitting up of the office for the Department in the New City Hall, Broad and Market Streets. Proposals as per sample and specifications were invited by my predecessor in office, through advertisements in newspapers in New York, Boston and Philadelphia, and the award made to the Gamewell Fire Alarm Telegraph Company in June, 1881; but owing to delay in the preparation of the rooms, etc., for the reception of the apparatus, the contract had not been executed up to September of this year. Since the making of the award, numerous improvements have been made by that company in their central office machinery, and I would have preferred to cancel it in order to take advantage of these improvements and substitute them for those advertised for, which had become somewhat antiquated; but on communication with the City Solicitor as to whether the award made at the time was binding upon the City and contractor, he replied that the award as made was equally binding upon both parties in interest, and could not be cancelled without mutual consent and re-advertisement; the Gamewell Company not agreeing thereto, the City was bound to comply with the provisions of the award, as though a contract had been duly executed at that time. Upon receipt of that opinion I, in the latter part of September, signed the contract prepared by the City Solicitor, for the completion of the work by April 1, 1886. After a long delay the quarters set apart for this Department in the New City Hall are about being completed, and I have reasons to believe that they will be superior to any in the country, as an effort has been made by the Building Commissioners to make them so. It is expected that an arrangement for moving a portion of the service will be completed on or before July of 1886.

For the reception of all electrical conductors that will enter the new quarters a brick conduit has been constructed by the Building Commission, at the request of this Department, under plans formulated by their Architect, with inside dimensions of five (5) feet by six (6) feet six (6) inches, extending from the northeast corner of the building to the curb line, a distance of one hundred and twenty-four (124) feet; and northeast from that point a twenty (20) inch iron pipe has been laid to a brick manhole on a line with the south side of Filbert Street, a distance of eighty-five (85) feet; from that point two branches of the same size pipe diverge, one eastward on the south line of Filbert Street to a brick manhole, a distance of fifty (50) feet; the other northeasterly to a brick manhole on the east side of Juniper Street, north of Filbert, a distance of sixty-five (65) feet, making a total length of brick and iron conduit of three hundred and twenty-four (324) feet. Owing to the structures already in the street, it became necessary to lay it at a depth of ten (10) feet. The iron pipe is coated on the inside with asphaltum; and in order to obtain a flat surface for the cables to lie upon, a two-inch plank has been rounded off to fit, placed in the bottom, and covered with asphaltum. The dimensions of the manholes are three (3) feet six (6) by four (4) feet six (6), and twelve (12) feet in depth, rounded at the top to a diameter of twenty (20) inches. Within the building all the necessary ducts and troughs for the reception of the cables, etc., have been constructed and so arranged that the conductors laid in them are easy of access.

AN ACT

FOR THE

ERECTION OF THE PUBLIC BUILDINGS.

AN ACT *to provide for the erection of all the Public Buildings required to accommodate the Courts, and for all Municipal purposes, in the City of Philadelphia, and to require the appropriation, by said City, of Penn Squares, at Broad and Market Streets, to the Academy of Fine Arts, the Academy of Natural Sciences, the Franklin Institute, and the Philadelphia Library, in the event of the said Squares not being selected by a vote of the people, as the site for the Public Buildings for said City.*

Section 1. BE IT ENACTED by the Senate and House of Representatives of the Commonwealth of Pennsylvania, in General Assembly met, and it is hereby enacted by the authority of the same: That THEODORE CUYLER, JOHN RICE, SAMUEL C. PERKINS, JOHN PRICE WETHERILL, LEWIS C. CASSIDY, HENRY M. PHILLIPS, WILLIAM L. STOKES, WILLIAM DEVINE, the MAYOR OF THE CITY OF PHILADELPHIA, and the PRESIDENTS OF SELECT AND COMMON COUNCILS, for the time being, are constituted Commissioners for the erection of the Public Buildings required to accommodate the Courts, and for all Municipal purposes, in the City of Philadelphia, who shall organize within thirty days, procure such plans for said buildings adapted to either of said sites hereinafter named, as in their judgment may be needful; appoint of their own number a President, and from other than their own number a Secretary, Treasurer, Solicitor, a competent Architect and assistants, and other employees; fix the compensation of each person employed by them, and do all other acts necessary in their judgment to carry out the intent of this act in relation to said Public Buildings; fill any vacancies which may happen by death, resignation, or otherwise, and if in the judgment of said Commission they shall deem it advisable to increase their number, they may, by a vote of a majority of their whole number, increase said Commission from time to time to any number not exceeding thirteen. The said Commissioners are hereby authorized and directed to locate said buildings on either Washington Square or Penn Square, as may be determined by a vote of the legally-qualified voters of the City of Philadelphia, at the next general election in October, one thousand eight hundred and seventy, and the Sheriff shall issue his proclamation, and the City Commissioners and other proper officers of said City shall provide all things that may be needful to enable the voters to decide by ballot their choice of a site for said Public Buildings, and the Return Clerks shall certify to the Prothonotary the result of said election, in the usual form required for other elections. And as soon as said choice is determined by a vote of the people, as provided in this act, the said Commissioners shall, within thirty days thereafter, advertise for proposals, and make all needful contracts for the construction of said buildings, as soon thereafter as may be found practicable, which contracts shall be valid and binding in law upon the City, and upon the Contractors, when approved by a majority of the said Board of Commissioners; and the said Commissioners shall make requisition on the Councils of said City, prior to the first day of December in each year, for the amount of money required by them for the purposes of the Commission for the succeeding year, and said Councils shall levy a special tax, sufficient to raise the amount so required. *Provided,* That said Councils may at any time make appropriations out of the annual tax in aid of the purposes of this act. *And provided further,* That the amount to be expended by said Commissioners shall be strictly limited to the sum required to satisfy their contracts for the erection of said buildings, and for the proper and complete furnishing thereof; and as soon as any part of said buildings may be completed and furnished ready for occupancy, they shall be occupied by the Courts, or such branches of the Municipal Government as they are intended for by said Commissioners; and upon the completion of a sufficient portion of said buildings to accommodate the Courts and Municipal Offices, the buildings now occupied by them respectively shall be vacated and removed, and upon the entire completion of the new buildings, all the present buildings on Independence

Square, except Independence Hall, shall be removed, and the ground placed in good condition by said Commission as part of their duty under this act, the expense of which shall be paid out of their general fund provided by this act, and thereupon the said Independence Square shall be and remain a public walk and green for ever.

And be it further provided, That in the event of Washington Square being selected by a majority of votes as the location for the said Public Buildings, then and in that event the Councils of the City of Philadelphia are hereby authorized, empowered and required to set apart for and convey by proper deeds or grants of conveyance, or by proper assurances of the right to occupy said squares, which the Mayor of Philadelphia shall duly sign and execute under the seal of said City, the four squares of ground known as Penn Squares, located at the intersection of Broad and Market Streets, in the City of Philadelphia, as laid down on the present map of said City, one to each of the following institutions: the Academy of Fine Arts, the Academy of Natural Sciences, the Franklin Institute, and the Philadelphia Library, for the purpose of allowing them to erect thereon ornamental and suitable buildings for the~~ir~~ respective institutions. The location of such buildings and the plans thereof to be approved by the Commissioners appointed under this act, and their successors in office, together with the time of erection, and all other matters appertaining thereto: *Provided, however,* That all expenses connected with said conveyances, plans, and other information requisite for the said Commission to have, shall be paid by the institutions respectively. In the event of the ultimate selection of Penn Squares as the site for said Public Buildings, the said Commission shall have authority and they are hereby empowered to vacate so much of Market and of Broad Streets as they may deem needful: *Provided, however*, That the streets passing around said buildings shall not be of less width than one hundred feet. It shall be the duty of the Mayor, the City Controller, City Commissioners, and City Treasurer, and of all other officers of the City, and also the duty of the Councils of the City of Philadelphia, to do and perform all such acts in aid and promotion of the intent and purpose of this Act of Assembly as said Commission may from time to time require. All laws and parts of laws restricting the uses and purposes of said Squares, or any of them, that may be in conflict with the intention and purpose of this act, be and the same are hereby repealed.

B. B. STRANG,
Speaker of the House of Representatives.

CHARLES H. STINSON,
Speaker of the Senate.

Approved the fifth day of August, Anno Domini one thousand eight hundred and seventy.

JOHN W. GEARY.

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